(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 387 254 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
16.11.2011 Bulletin 2011/46

(21) Application number: **11176831.3**

(22) Date of filing: **27.02.2009**

(51) Int Cl.:
H04R 5/04 *(2006.01)* *H04R 29/00* *(2006.01)*
H04R 5/033 *(2006.01)* *H04R 1/10* *(2006.01)*

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK TR

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
09154033.6 / 2 224 749

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Remarks:
This application was filed on 08-08-2011 as a divisional application to the application mentioned under INID code 62.

(54) Method and system for controlling a maximum signal level output to headphones coupled to a wireless device

(57) A method for controlling a maximum signal level output to headphones of a wireless device is provided. The method includes: determining an impedance of the headphones; determining a carrier specific maximum signal level for headphones having the impedance; and, adjusting an audio amplifier of the wireless device coupled to the headphones to restrict the maximum signal level output to the headphones to the carrier specific maximum signal level.

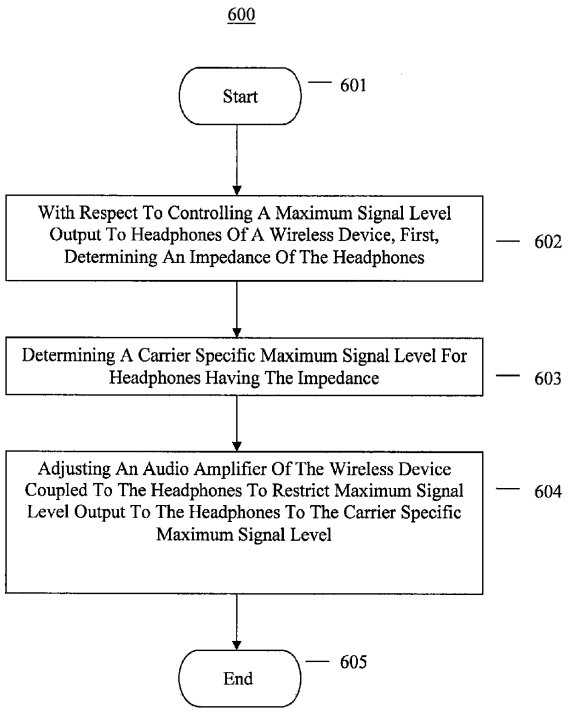

FIG. 6

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Description

FIELD OF THE APPLICATION

[0001] This application relates to the field of wireless devices, and more specifically, to a method and system for controlling a maximum signal level output to headphones coupled to a wireless device.

BACKGROUND

[0002] Current wireless mobile communication devices include microprocessors, memory, soundcards, speakers, headphones, and run one or more software applications in addition to providing for voice communications. Examples of software applications used in these wireless devices include micro-browsers, address books, email clients, instant messaging ("IM") clients, and wavetable instruments. Additionally, wireless devices have access to a plurality of services via the Internet. A wireless device may, for example, be used to browse web sites on the Internet, to transmit and receive graphics, and to execute streaming audio and/or video applications. Such wireless devices may operate on a cellular network, on a wireless local area network ("WLAN"), or on both of these types of networks.

[0003] One problem with current wireless devices pertains to the adjustment of maximum output sound pressure levels for headphones coupled to such devices. Headphones are typically used to listen to voice calls, radio programs, audio programs (e.g., music), etc., stored on or accessed by the wireless device. In particular, the maximum output sound pressure level for headphones for wireless devices and handheld products is legally constrained in several jurisdictions in order to protect users from hearing loss. For example, European Standard EN 50332-1:2000, dated March 2000 and entitled "Sound System Equipment: Headphones And Earphones Associated With Portable Audio Equipment - Maximum Sound Pressure Level Measurement Methodology And Limit Considerations - Part 1: General Method For 'One Package Equipment'", and which is incorporated herein by reference, restricts maximum sound pressure level at the headphones (i.e., for headphones provided with the portable audio equipment and from the same manufacturer) to 100 dB. In addition, European Standard EN 50332-2:2003, dated October 2003 and entitled "Sound System Equipment: Headphones And Earphones Associated With Portable Audio Equipment - Maximum Sound Pressure Level Measurement Methodology And Limit Considerations - Part 2: Matching Of Sets With Headphones If Either Or Both Are Offered Separately", and which is incorporated herein by reference, restricts maximum sound pressure level at the headphones (i.e., for headphones provided separately from the portable audio equipment by a different manufacturer) to 94 dB. Measurement of maximum sound pressure levels according to these standards is specified with respect to headphones having an impedance of 32 Ohms. One problem relating to such standards is that in order to set the output signal level (e.g., in mV RMS) appropriately at the output jack of the wireless device in order to meet the maximum sound pressure level specified, the impedance of the headphones must be known. This is especially problematic if the headphones are not provided by the manufacturer as a package with the wireless device.

[0004] A need therefore exists for an improved method and system for controlling a maximum signal level output to headphones coupled to a wireless device. Accordingly, a solution that addresses, at least in part, the above and other shortcomings is desired.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] Features and advantages of the embodiments of the present application will become apparent from the following detailed description, taken in combination with the appended drawings, in which:

[0006] FIG. 1 is a front view illustrating a wireless device coupled to headphones and adapted for implementing an embodiment of the application;

[0007] FIG. 2 is a block diagram illustrating the wireless device of FIG. 1 and a wireless network adapted for implementing an embodiment of the application;

[0008] FIG. 3 is a block diagram illustrating a memory of the wireless device of FIGS. 1 and 2;

[0009] FIG. 4 is a block diagram illustrating a headphones subsystem in accordance with an embodiment of the application;

[0010] FIG. 5 is a block diagram illustrating an alternate headphones subsystem in accordance with an embodiment of the application; and,

[0011] FIG. 6 is a flow chart illustrating operations of modules within the memory of a wireless device for controlling maximum signal level output to headphones of the wireless device, in accordance with an embodiment of the application.

[0012] It will be noted that throughout the appended drawings, like features are identified by like reference numerals.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0013] In the following description, details are set forth to provide an understanding of the application. In some instances, certain software, circuits, structures and techniques have not been described or shown in detail in order not to obscure the application. Embodiments of the present application may be implemented in any computer programming language provided that the operating system of the wireless device or data processing system provides the facilities that may support the requirements of the application. Any limitations presented would be a result of a particular type of operating system or computer programming language and would not be a limitation of

the present application. Embodiments of the preset application may also be implemented in hardware or in a combination of hardware and software.

[0014] According to one embodiment of the application, there is provided a method for controlling a maximum signal level output to headphones of a wireless device. The method includes: determining an impedance of the headphones; determining a carrier specific maximum signal level for headphones having the impedance; and, adjusting an audio amplifier of the wireless device coupled to the headphones to restrict the maximum signal level output to the headphones to the carrier specific maximum signal level.

[0015] FIG. 1 is a front view illustrating a wireless device **100** coupled to headphones **105** (a.k.a., headphone set, headphone, headset, earphone, earphones, etc.) and adapted for implementing an embodiment of the application. The wireless device **100** includes a casing **150,** a display screen **122,** a graphical user interface ("GUI") **180** displayed on the display screen **122,** a keyboard (or keypad) **132,** a trackball (or thumbwheel) **110,** various select buttons **120,** various inputs/outputs (e.g., power connector jack, data interface ports, etc.) **160,** and a headphones jack **106.** Internally, the wireless device **100** includes one or more circuit boards (not shown), a CPU **138,** memory **124, 126, 200,** a battery **156,** an antenna (not shown), etc., which are operatively coupled to the various inputs/outputs **160,** the keyboard **132,** the display screen **122,** the headphones jack **106,** etc., as will be described below.

[0016] The headphones **105** are coupled to the wireless device **100** by a headphones cable or lead **107** which is inserted into the headphones jack **106.** The headphones **105** include a speaker assembly which is inserted into or placed over a user's ear. According to one embodiment, the headphones **105** include two speaker assemblies, one for each of the user's ears. Each speaker assembly includes a speaker having an impedance (referred to as the impedance of the headphones in the following). The headphones **105,** headphones jack **106,** and headphones cable **107** may be configured for stereo and/or mono operation. When the headphones cable **107** is inserted into the headphones jack 106, audio output signals may be switched from the internal speaker **134** (see FIG. 2) to the headphones **105.** Control of audio signal level (e.g., in mV RMS) output to the headphones **105** is performed by a headphones subsystem **400** as described below. According to one embodiment, the headphones jack **106** is a 3.5 mm headset jack adapted to support both a stereo headphones output and a mono microphone input.

[0017] FIG. 2 is a block diagram illustrating the wireless device **100** of FIG. 1 and a wireless network **220** adapted for implementing an embodiment of the application. The wireless network **220** may include antenna, base stations, access points, transceivers, supporting radio equipment, etc., as known to those of ordinary skill in the art, for supporting wireless communications between the wireless device **100** and other devices (not shown).

[0018] The wireless device **100** may be a two-way communication device having at least voice and advanced data communication capabilities, including the capability to communicate with other devices. Depending on the functionality provided by the device **100,** it may be referred to as a data messaging device, a two-way pager, a cellular telephone with data messaging capabilities, a wireless Internet appliance, a data communication device (with or without telephony capabilities), a Wi-Fi device, a WLAN device, a dual-mode (i.e., Wi-Fi and cellular) device, or a portable audio device.

[0019] The wireless device **100** has a communication subsystem **111,** which includes a RF receiver, a RF transmitter, and associated components. As will be apparent to those skilled in the field of communications, the particular design of the communication subsystem **111** depends on the communication network **220** in which the device **100** is intended to operate.

[0020] The device **100** may be capable of cellular network access and hence the device **100** may have a subscriber identity module (or "SIM" card) **162** for inserting into a SIM interface ("IF") **164** in order to operate on the cellular network (e.g., a global system for mobile communication ("GSM") network).

[0021] The device **100** may be a battery-powered device and so it may also include a battery IF **154** for receiving one or more rechargeable batteries **156.** The battery (or batteries) **156** provides electrical power to most if not all electrical circuitry in the device **100,** and the battery IF **154** provides for a mechanical and electrical connection for it.

[0022] The wireless device **100** includes a microprocessor **138,** also called a processor, which controls overall operation of the device **100.** The microprocessor **138** interacts with device subsystems such as the display 122, a flash memory 124 or other persistent store, a random access memory ("RAM") **126,** auxiliary input/output ("I/O") subsystems **128,** a serial port (e.g., a universal serial bus ("USB") port) **131,** the keyboard **132,** the trackball or thumbwheel **110,** the headphones **105,** an internal speaker **134,** a microphone **136,** a short-range communications subsystem **141,** and other device subsystems **142.** The microprocessor **138,** in addition to performing operating system functions, preferably enables execution of software applications on the device **100.**

[0023] FIG. 3 is a block diagram illustrating a memory **200** of the wireless device **100** of FIGS. 1 and 2. The microprocessor **138** is coupled to the memory **200.** The memory **200** has various hardware and software components for storing information (e.g., instructions, data, database tables, test parameters, etc.) for enabling operation of the device **100** and may include flash memory **124,** RAM **126,** ROM (not shown), disk drives (not shown), etc. In general, the memory **200** may include a variety of storage devices typically arranged in a hierarchy of storage as understood to those skilled in the art.

[0024] Operating system ("O/S") software modules

202 used by the microprocessor **138** may be stored in a persistent store such as the flash memory **124,** which may alternatively be a read-only memory ("ROM") or similar storage element (not shown). Those skilled in the art will appreciate that the operating system, specific device applications, or parts thereof, may be temporarily loaded into a volatile store such as RAM **126.**

[0025] To provide a user-friendly environment to control the operation of the device **100,** operating system ("O/S") software modules **202** resident on the device **100** provide a basic set of operations for supporting various applications typically operable through the GUI **180** and supporting GUI software modules **204.** For example, the O/S **202** provides basic input/output system features to obtain input from the auxiliary I/O **128,** the keyboard **132,** the trackball or thumbwheel **110,** and the like, and for facilitating output to the user through the display **122,** the speaker **134,** the headphones **105,** etc. According to one embodiment, the wireless device **100** is provided with hardware and/or software modules **206** for facilitating and implementing the method of the application as will be described below.

[0026] A user may interact with the wireless device **100** and its various software modules **202, 204, 206,** using the GUI **180.** GUIs are supported by common operating systems and provide a display format which enables a user to choose commands, execute application programs, manage computer files, and perform other functions by selecting pictorial representations known as icons, or items from a menu through use of an input or pointing device such as a trackball or thumbwheel **110** and keyboard **132.** The GUI **180** may include a cursor **190,** various selectable objects and icons **191,** and various windows **192.**

[0027] Thus, the wireless device **100** includes computer executable programmed instructions for directing the device **100** to implement the embodiments of the present application. The programmed instructions may be embodied in one or more hardware or software modules **206** which may be resident in the memory **200** of the wireless device **100.** Alternatively, the programmed instructions may be embodied on a computer readable medium (such as a CD disk or floppy disk) which may be used for transporting the programmed instructions to the memory of the wireless device **100.** Alternatively, the programmed instructions may be embedded in a computer-readable signal or signal-bearing medium that may be uploaded to a network **220** by a vendor or supplier of the programmed instructions, and this signal or signal-bearing medium may be downloaded through an interface **111, 131, 141** to the wireless device **100** from the network **220** by end users or potential buyers.

[0028] FIG. 4 is a block diagram illustrating a headphones subsystem **400** in accordance with an embodiment of the application. Components of the headphones subsystem **400** are generally contained in the wireless device **100** and are used to determine the impedance of the headphones **105** in order to adjust the maximum signal level (e.g., in mV RMS) output to the headphones **105** (and hence the maximum sound pressure level output by the headphones **105).**

[0029] According to one embodiment, the headphones system **400** includes a signal generator **410,** a digital to analog converter ("DAC") **440,** and an audio amplifier **430** for generating an inaudible high frequency signal (e.g., 25 kHz). The signal generator **410,** DAC **440,** and audio amplifier **430** are controlled by the microprocessor **138.** The audio amplifier **430** is coupled to the headphones **105** through a series resistor **R.** The series resistor **R** may have a low value (e.g., 5 Ohms) . A voltage **V** produced across the resistor **R** when the high frequency signal is applied to the resistor **R** and headphones **105** is indicative of the impedance **Z** of the headphones **105.** The signal may be applied to the resistor **R** and headphones **105** whenever the headphones **105** are connected to the headphones jack **106** via the headphones cable **107.** The voltage **V** is amplified by a microphone preamplifier **450** which is coupled to an analog to digital converter ("ADC") **420.** The ADC **420** monitors the voltage **V** and provides a digital signal indicative of the voltage **V** and hence the impedance **Z** of the headphones **105** to the microprocessor **138.** The ADC **420** may also be used by the microphone **136** of the wireless device **100** in order to reduce component count. The microprocessor **138** receives the digital signal from the ADC **420** and determines the impedance **Z** of the headphones **105** from it (e.g., by voltage divider principles, etc.). The microprocessor **138** may do this by accessing a table that stores voltage values (or digital signal values) and corresponding headphones impedance values.

[0030] Having determined the impedance **Z** for the headphones **105,** the microprocessor **138** controls the audio amplifier **430** to restrict the maximum signal level (e.g., in mV RMS) output to the headphones **105.** In this way, the sound pressure level output by the headphones **105** may be restricted to a maximum sound pressure level for the determined impedance **Z.** The microprocessor **138** may do this by accessing a table (e.g., included in or associated with modules **206)** that stores headphones impedance values, corresponding maximum signal level values for the audio amplifier **430,** and/or corresponding maximum sound pressure values for the headphones **105.** For example, for a headphones impedance value of approximately 32 Ohms, the table **406** may indicate that the maximum sound pressure level for the headphones **105** is 100 dB.

[0031] According to one embodiment, if a headphone impedance value corresponding to the determined headphone impedance **Z** is not listed in the table **406,** no maximum signal level for the audio amplifier **430** and no maximum sound pressure level for the headphones **105** is prescribed and hence the maximum signal level of the audio amplifier **430** and the maximum sound pressure level for the headphones **105** are not restricted for that value of determined headphones impedance **Z.**

[0032] Now, the maximum signal level (e.g., in mV

RMS) and/or the maximum sound pressure level (e.g., in dB) for a given headphones impedance may be set by government regulation which may change depending on the carrier or the location in which the wireless device 100 is operating or is sold. As is known to those skilled in the art, the wireless device **100** has means for determining its carrier and/or location and hence the government regulations that may apply to set maximum signal levels and/or maximum sound pressure levels. Thus, according to one embodiment, the microprocessor **138** receives a signal indicative of the carrier and/or location of the wireless device **100** and determines whether a maximum signal level value and/or a maximum sound pressure level value has been prescribed for the carrier and/or location and for the determined headphones impedance **Z.** The microprocessor **138** may do this by accessing a table **406** that stores wireless device location, corresponding headphones impedance values, corresponding carrier (or location) specific maximum signal level values (if any) for the audio amplifier **430,** and/or corresponding carrier (or location) specific maximum sound pressure level values (if any) for the headphones **105.** For example, the table may indicate that if the wireless device **100** is associated with a carrier based in Great Britain and if the headphones impedance is 32 Ohms (i.e., +/- 20%), then the maximum sound pressure level should be restricted to 100 dB (i.e., if the headphones **105** and wireless device **100** are sold as a package). As another example, the table **406** may indicate that if the wireless device **100** is associated with a carrier based in Great Britain and if the headphones impedance is 32 Ohms (i.e., +/- 20%), then the maximum sound pressure level should be restricted to 94 dB (i.e., if the headphones **105** and wireless device **100** are not sold as a package).

[0033] Similarly, the maximum signal level (e.g., in mV RMS) and/or the maximum sound pressure level (e.g., in dB) may be set by government regulation which may change depending on the carrier or the location in which the wireless device **100** is operating or is sold (i.e., irrespective of the impendence of the headphones **105).** Again, as is known to those skilled in the art, the wireless device **100** has means for determining its carrier and/or location and hence the government regulations that may apply to set maximum signal levels and/or maximum sound pressure levels. Thus, according to one embodiment, the microprocessor **138** receives a signal indicative of the carrier and/or location of the wireless device **100** and determines whether a maximum signal level value and/or a maximum sound pressure level value has been prescribed for the carrier and/or location. The microprocessor **138** may do this by accessing a table **406** that stores wireless device carrier (or location), corresponding headphones impedance values, corresponding carrier specific maximum signal level values (if any) for the audio amplifier **430,** and/or corresponding carrier specific maximum sound pressure level values (if any) for the headphones **105.** For example, the table **406** may indicate that if the wireless device **100** is associated with a carrier based in Great Britain, then the maximum sound pressure level should be restricted to 100 dB (i.e., if the headphones **105** and wireless device **100** are sold as a package). As another example, the table **406** may indicate that if the wireless device **100** is associated with a carrier based in Great Britain, then the maximum sound pressure level should be restricted to 94 dB (i.e., if the headphones **105** and wireless device **100** are not sold as a package).

[0034] According to one embodiment, updates to the table **406** storing carrier (or wireless device location), corresponding headphones impedance values, corresponding carrier specific maximum signal level values (if any) for the audio amplifier **430,** and corresponding carrier specific maximum sound pressure level values (if any) for the headphones **105** may be periodically downloaded to the wireless device **100** (e.g., over the network **220).**

[0035] According to one embodiment, the carrier associated with the wireless device **100** may be determined from messages delivered to the wireless device **100** over the network **220.** According to another embodiment, the carrier may be determined from information stored in the wireless device's SIM card **162.**

[0036] According to one embodiment, the location of the wireless device **100** may be determined from messages delivered to the wireless device **100** over the network **220.** According to another embodiment, the location of the wireless device **100** may be determined by a global positioning system ("GPS") receiver (not shown) optionally provided for the device **100.** According to another embodiment, the location of the wireless device **100** may be determined from the location of antennae towers associated with the network **220** on which the wireless device **100** operates.

[0037] FIG. 5 is a block diagram illustrating an alternate headphones subsystem **400** in accordance with an embodiment of the application. In FIG. 5, a signal source **510** (e.g., microprocessor **138)** generates a signal (e.g., an audio signal, an inaudible audio signal, etc.) that is applied to a digital to analog converter ("DAC") **540.** The output of the DAC **540** is conditioned **530** (e.g., amplified **430,** etc.) to allow for impendence measurement **520** (e.g., via a resistor **R,** etc.) of the headphones **105** connected to the headphones jack **506.**

[0038] The application may provide several advantages. For example, the method of the present application allows wireless devices **100** to restrict maximum signal levels and maximum sound pressure levels to prescribed legal limits when necessary.

[0039] Aspects of the above described method may be illustrated with the aid of a flowchart. FIG. 6 is a flow chart illustrating operations **600** of modules **206** within the memory **200** of a wireless device **210** for controlling maximum signal level output to headphones **105** of the wireless device **100,** in accordance with an embodiment of the application.

[0040] At step **601,** the operations **600** start.

[0041] At step **602,** an impedance **Z** of the headphones

105 is determined.

[0042] At step **603,** a carrier specific maximum signal level for headphones having the impedance **Z** is determined.

[0043] At step **604,** an audio amplifier **430** of the wireless device **100** coupled to the headphones **105** is adjusted to restrict the maximum signal level output to the headphones **105** to the carrier specific maximum signal level.

[0044] At step **605,** the operations **600** end.

[0045] The above described method is generally performed by the wireless device **100.** However, according to one embodiment, the method can be performed by, or in combination with, a data processing system (not shown) such a personal computer ("PC") or server, a stereo system, a television system, etc.

[0046] While embodiments of this application are primarily discussed as a method, a person of ordinary skill in the art will understand that the apparatus discussed above with reference to a wireless device **100** and a data processing system, may be programmed to enable the practice of the method of these embodiments. Moreover, an article of manufacture for use with a wireless device **100** or data processing system, such as a pre-recorded storage device or other similar computer readable medium including program instructions recorded thereon, may direct the wireless device **100** or data processing system to facilitate the practice of the method of these embodiments. It is understood that such apparatus and articles of manufacture also come within the scope of the application.

[0047] Furthermore Aspects and features of this disclosure are set out in the flowing paragraphs provided as clauses, which correspond to the claims of the parent application as filed:

1. A method for controlling a maximum signal level output to headphones of a wireless device, comprising:

    determining an impedance of the headphones;
    determining a carrier specific maximum signal level for headphones having the impedance; and,
    adjusting an audio amplifier of the wireless device coupled to the headphones to restrict the maximum signal
    level output to the headphones to the carrier specific maximum signal level.

2. The method of clause 1 wherein the determining of the carrier specific maximum signal level further comprises searching a table stored in the wireless device using the impedance, the table listing impedances and corresponding carrier specific maximum signal levels.

3. The method of clause 1 or clause 2 wherein the determining of the impedance further comprises applying an audio signal to the headphones.

4. The method of clause 3 wherein the audio signal is an inaudible audio signal.

5. The method of clause 1 and further comprising determining a carrier for the wireless device and wherein the carrier specific maximum signal level for headphones having the impedance is determined for the carrier.

6. The method of clause 5 wherein the determining of the carrier specific maximum signal level further comprises searching a table stored in the wireless device using the impedance and the carrier, the table listing impedances, carriers, and corresponding carrier specific maximum signal levels.

7. The method of clause 5 or clause 6 wherein the carrier is determined from a signal received from a network in which the wireless device is operating.

8. The method of clause 1 and further comprising determining a location for the wireless device and wherein the carrier specific maximum signal level for headphones having the impedance is determined for the location.

9. The method of clause 8 wherein the determining of the carrier specific maximum signal level further comprises searching a table stored in the wireless device using the impedance and the location, the table listing impedances, locations, and corresponding carrier specific maximum signal levels.

10. The method of clause 8 or clause 9 wherein the location is determined from a signal received from a network in which the wireless device is operating.

11. A system within a wireless device for controlling a maximum signal level output to headphones coupled to the wireless device, comprising:

    a memory storing program instructions; and
    a processor coupled to said memory and configured to execute said program instructions to cause the system to implement the steps of the method of any one of clauses 1 to 10.

12. A wireless device having a system according to clause 11.

13. A computer readable medium containing program instructions executable by a processor of a wireless device for causing said wireless device to implement the steps of the method of any one of clauses 1 to 10.

[0048] The embodiments of the application described above are intended to be exemplary only. Those skilled in this art will understand that various modifications of detail may be made to these embodiments, all of which come within the scope of the application.

Claims

1. A method for controlling a maximum signal level output to headphones (105) of a wireless device (100), comprising:

   determining an impedance of the headphones (105), **characterised in that** the method further includes:

   accessing from memory (200) in the wireless device (100) a carrier specific maximum signal level for headphones (105) having the impedance, wherein the carrier specific maximum signal level is a maximum signal level prescribed for a location of the wireless device (100) and for headphones (105) having the impedance; and,
   adjusting an audio amplifier (430) of the wireless device (100) coupled to the headphones (105) to restrict the maximum signal level output to the headphones (105) to the carrier specific maximum signal level;

   wherein the memory (200) stores impedances, locations, and corresponding carrier specific maximum signal levels.

2. The method of claim 1 wherein the impedances, locations, and corresponding carrier specific maximum signal levels are stored in a searchable table in the memory (200).

3. The method of claim 1 or claim 2 wherein the determining of the impedance further comprises applying an audio signal to the headphones (105).

4. The method of claim 3 wherein the audio signal is an inaudible audio signal.

5. The method of any one of claims 1 to 4 and further comprising determining the location.

6. The method of claim 5 wherein the location is determined from one of:

   a signal received from a network (220) in which the wireless device (100) is operating.
   a global positioning system ("GPS") receiver of the wireless device (100).
   the location of antennae towers associated with a network (220) in which the wireless device (100) operates.

7. The method of any one of claims 1 to 6 wherein the carrier specific maximum signal level is a maximum signal level prescribed for a carrier for the wireless device (100), the location of the wireless device (100), and for the headphones (105) having the impedance.

8. The method of claim 7 wherein the memory (200) further stores carriers.

9. The method of claim 8 wherein the carriers are stored in the searchable table in the memory (200).

10. The method of claim 7 and further comprising determining the carrier.

11. The method of claim 10 wherein the carrier is determined from one of:

    a signal received from a network (220) in which the wireless device (100) is operating;
    from information stored in a subscriber identity module ("SIM") (162) of the wireless device (100).

12. The method of any one of claims 1 to 11 wherein the adjusting of the audio amplifier (430) is performed if the carrier specific maximum signal level can be determined for the impedance.

13. A system for a wireless device (100) for controlling a maximum signal level output to headphones (105) coupled to the wireless device (100), comprising:

    a memory (200) storing program instructions; and
    a processor (138) coupled to said memory (200) and configured to execute said program instructions to cause the system to implement the steps of the method of any one of claims 1 to 12.

14. A wireless device (100) having a system according to claim 13.

15. A computer readable medium containing program instructions executable by a processor of a wireless device (100) for causing said wireless device (100) to implement the steps of the method of any one of claims 1 to 12.

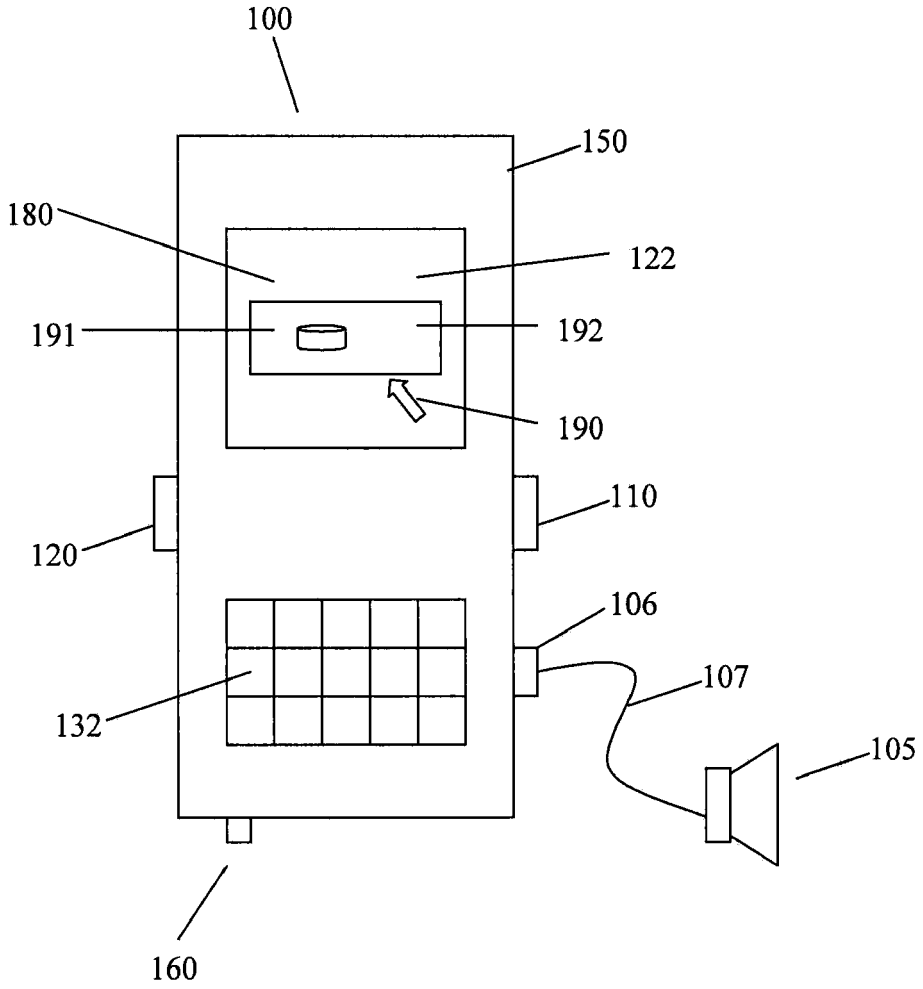

FIG. 1

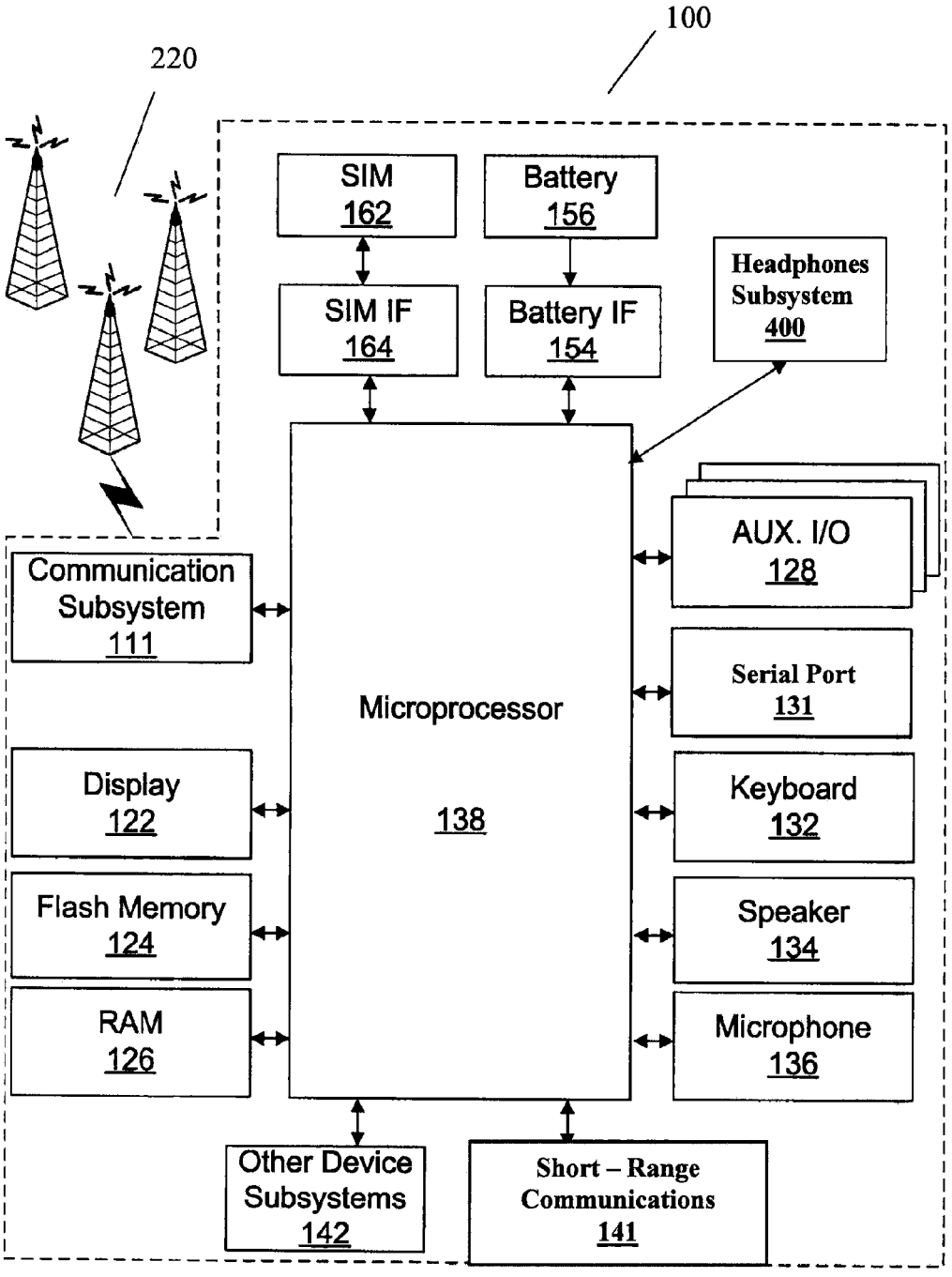
100
220
SIM
162
Battery
156
Headphones
Subsystem
400
SIM IF
164
Battery IF
154
AUX. I/O
128
Communication
Subsystem
111
Microprocessor
138
Serial Port
131
Display
122
Keyboard
132
Flash Memory
124
Speaker
134
RAM
126
Microphone
136
Other Device
Subsystems
142
Short – Range
Communications
141

FIG. 2

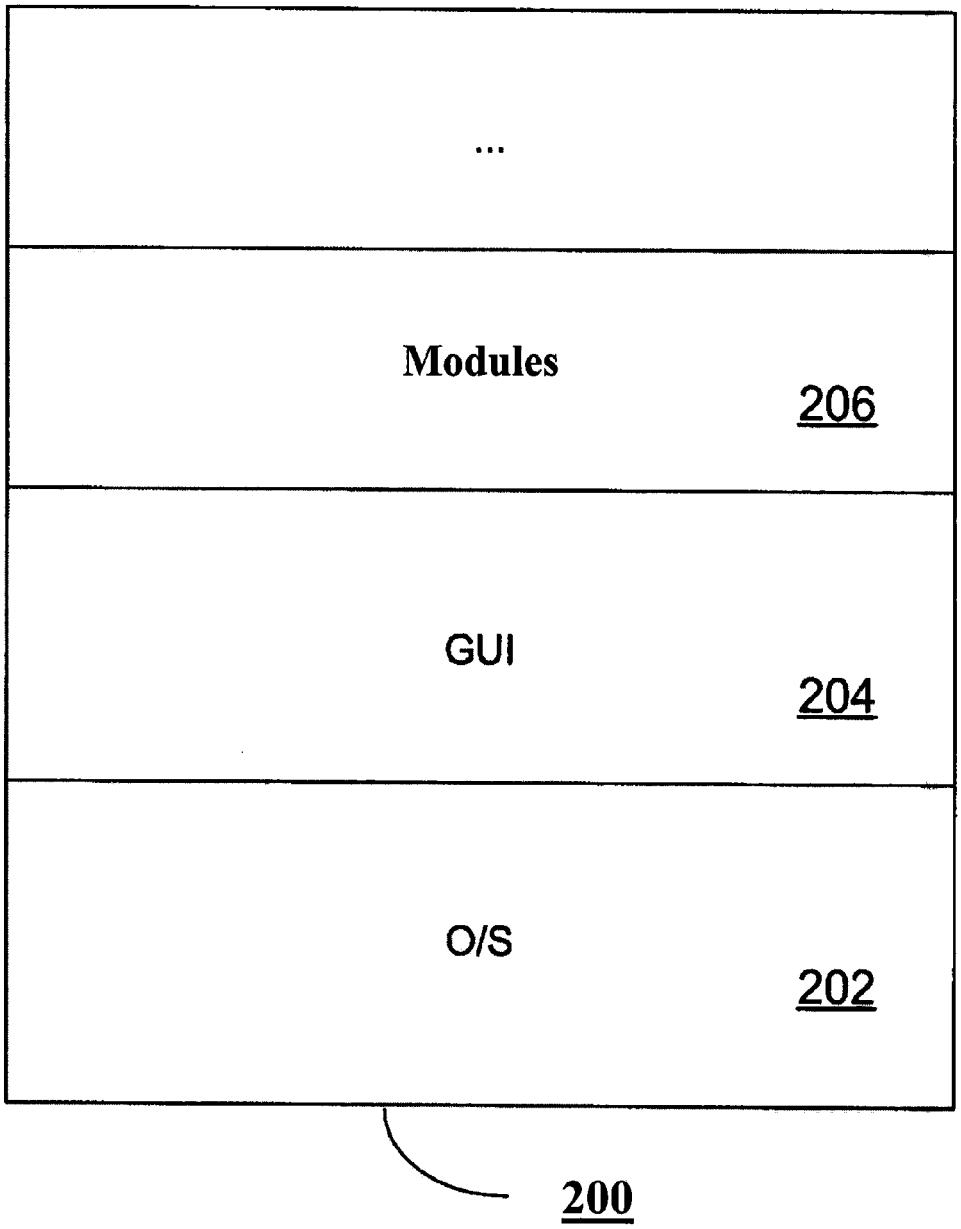

FIG. 3

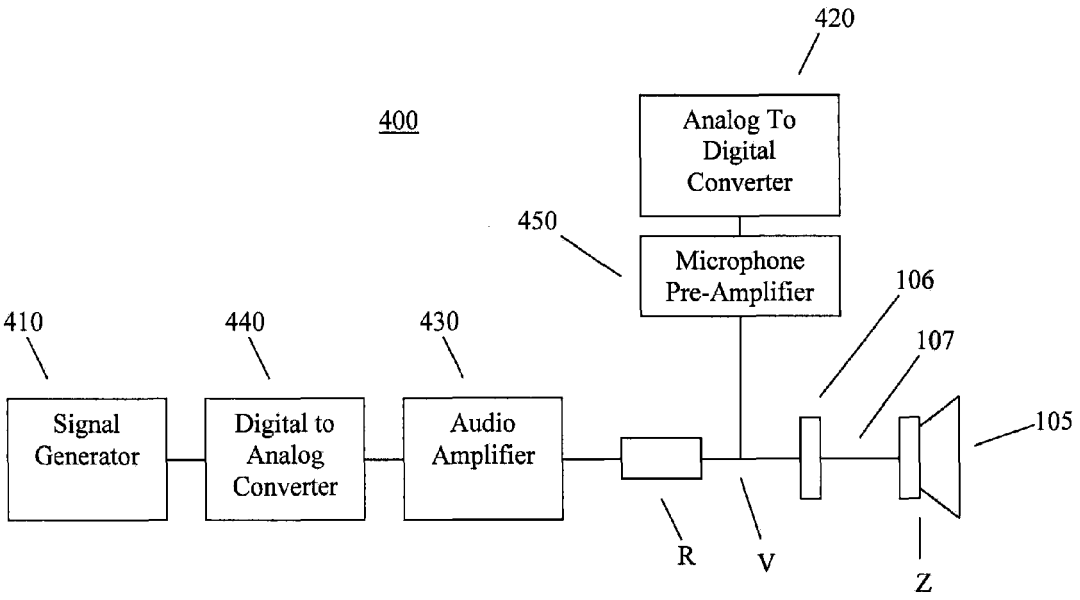
420
400
Analog To Digital Converter
450
Microphone Pre-Amplifier
106
107
410
440
430
105
Signal Generator
Digital to Analog Converter
Audio Amplifier
R
V
Z

FIG. 4

400

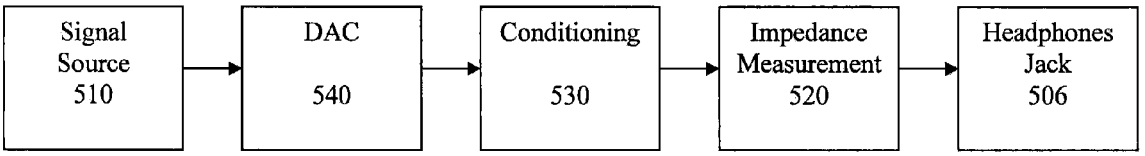
Signal Source 510
DAC 540
Conditioning 530
Impedance Measurement 520
Headphones Jack 506

FIG. 5

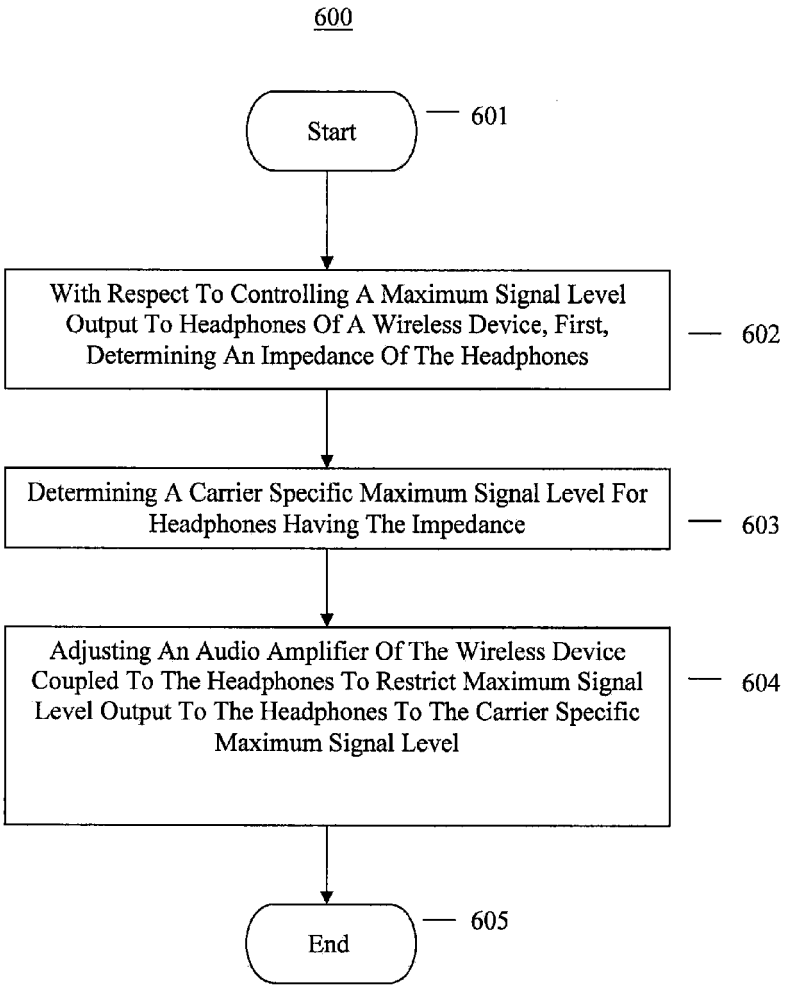
600
Start
601
With Respect To Controlling A Maximum Signal Level Output To Headphones Of A Wireless Device, First, Determining An Impedance Of The Headphones
602
Determining A Carrier Specific Maximum Signal Level For Headphones Having The Impedance
603
Adjusting An Audio Amplifier Of The Wireless Device Coupled To The Headphones To Restrict Maximum Signal Level Output To The Headphones To The Carrier Specific Maximum Signal Level
604
End
605

FIG. 6